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Orapuh Journal

ORIGINAL ARTICLE

Journal of Oral & Public Health

Factors associated with urinary lithiasis detected by ultrasound and radiography at the Cinquantenaire Hospital of Kisangani

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ARTICLE INFO

Received: *24 January 2026*
Accepted: *21 February 2026*
Published: *27 March 2026*

Keywords:
Urinary lithiasis, associated factors, ultrasound, radiography, Kisangani

Peer-Review: *Externally peer-reviewed*

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To cite:
Bambale, J.-P. L., Ahuka, L. L., Mazoba, T. K., Kakule, L. L., Mbongo, A. T., Falay, D. S., Tagoto, A. T., Bisuta, S. F., Kayembe, C. T., & Molua, A. A. (2026). Factors associated with urinary lithiasis detected by ultrasound and radiography at the Cinquantenaire Hospital of Kisangani. *Orapuh Journal, 7*(2), e1419
https://dx.doi.org/10.4314/orapj.v7i2.19

ISSN: *2644-3740*

Published by Orapuh, Inc. (info@orapuh.org)

Editor-in-Chief: Prof. V. E. Adamu
Orapuh, F. Gaye R., Sukuta, Greater Banjul, The Gambia, editor@orapuh.org.

ABSTRACT

Introduction

Urinary lithiasis is an increasingly significant public health concern in sub-Saharan Africa. However, in the Democratic Republic of the Congo (DRC), epidemiological data and factors associated with this condition remain limited.

Purpose

This study aimed to analyze factors associated with urinary lithiasis among patients examined in Kisangani.

Methods

A cross-sectional analytical study was conducted involving 303 patients who underwent ultrasound and/or radiography for suspected urinary lithiasis at the Cinquantenaire Hospital of Kisangani between 2020 and 2024. Qualitative variables were expressed as proportions, while age was presented as mean ± standard deviation. Bivariate analysis was performed to identify significant associations using Pearson's chi-square test or Fisher's exact test at a 5% significance level. Crude odds ratios (ORs) with 95% confidence intervals (CIs) and Wald p-values were calculated.

Results

The mean age of the patients was 41.9 ± 15.3 years, with a predominance of individuals aged 30 to 49 years. Bivariate analysis revealed a statistically significant association between urinary lithiasis and a personal history of lithiasis (crude OR = 3.43, p = .030), as well as the presence of a urinary tract infection (crude OR = 2.45, p = .012).

Conclusion

Young adulthood, a history of kidney stones, and urinary tract infection appear to be significantly associated factors. These findings highlight the need to strengthen targeted ultrasound screening and to integrate the management of risk factors into local public health strategies.

INTRODUCTION

Urinary lithiasis, more commonly known as kidney stones, is a frequent urological condition that can cause pain and complications such as pyelonephritis and acute renal failure, and it often recurs. Appropriate prevention and treatment are essential, as they contribute to improving patients' quality of life (Wróblewski et al., 2026).

A recent meta-analysis including more than one million participants estimated the global prevalence of urinary lithiasis at approximately 10.85%, indicating that nearly one in ten individuals may be affected during their lifetime (Vera-Ponce et al., 2025). This prevalence varies depending on geographic region, diagnostic methods, and population characteristics. These findings confirm that urinary lithiasis is a widespread and increasingly prevalent condition worldwide.

In sub-Saharan Africa, recent data suggest a substantial burden of urinary lithiasis, with marked heterogeneity in clinical profiles and associated factors depending on healthcare access and socioeconomic conditions (Kassaw et al., 2024). Several factors have been implicated in the development and recurrence of urinary lithiasis, including age, sex, personal history of lithiasis, metabolic and cardiovascular comorbidities (e.g., diabetes and hypertension), urinary tract infections, and fluid and dietary habits (Ferraro et al., 2022; He et al., 2025). Identifying these associated factors is essential for guiding prevention strategies, stratifying recurrence risk, and optimizing patient management.

From a pathophysiological perspective, kidney stones result from an imbalance between factors that promote crystallization and those that inhibit it, leading to urinary supersaturation and precipitation of mineral salts. Metabolic disorders (e.g., hypercalciuria, hyperuricosuria, hypocitraturia), variations in urinary pH, and certain clinical conditions (e.g., metabolic syndrome and urease-producing bacterial infections) play a key role in the formation of different types of stones, particularly calcium and uric acid lithiasis (Skolarikos et al., 2025). This complexity explains the diversity of patient profiles and highlights the need for individualized diagnostic and preventive approaches.

Non-contrast computed tomography (CT) is considered the gold standard in acute settings due to its high diagnostic accuracy. Ultrasound enables the assessment of urinary obstruction with minimal radiation exposure, while abdominal radiography (kidneys, ureters, and bladder [KUB]) is particularly useful for detecting radiopaque stones and for follow-up (Gupta et al., 2023; Skolarikos et al., 2025). In resource-limited settings, the combination of ultrasound and radiography remains a relevant alternative for detecting lithiasis, assessing complications, and guiding management.

However, scientific data on urinary lithiasis remain limited in the Democratic Republic of the Congo (DRC), particularly in Kisangani, largely due to the lack of comprehensive evaluation of locally relevant risk factors. This gap hinders the development of effective public health policies, especially regarding prevention and management of complications associated with urinary lithiasis.

The present study aims to describe the epidemioclinical profile of patients diagnosed using ultrasound and/or radiography and to analyze the main factors associated with urinary lithiasis in this setting. The findings are expected to provide locally relevant data to support prevention strategies, improve patient management, and reduce the risk of recurrence.

METHODS

Study Setting

This study was conducted in the Department of Radiology and Medical Imaging at the Cinquantenaire Hospital of Kisangani, Democratic Republic of the Congo.

Study Design

This was a quantitative analytical study designed to identify factors associated with urinary lithiasis detected by radiography and ultrasound in patients examined during the study period.

Study Population and Sample Size

A comprehensive sampling of medical records was conducted for patients who underwent imaging for suspected urinary lithiasis. A total of 303 patient records met the inclusion criteria and were included in the study.

Inclusion and Exclusion Criteria

Inclusion Criteria

Medical records were included if they met the following criteria:

- Patients who underwent renal–vesical ultrasound and/or abdominal radiography (plain film) for suspected urinary lithiasis at the Cinquantenaire Hospital of Kisangani between 2020 and 2024, regardless of age or sex.
- Records containing a usable radiological report indicating the presence or absence of urinary lithiasis, along with the minimum clinical information required for analysis.

Non-Inclusion Criteria

Records were not included if:

- Imaging was performed for indications other than suspected urinary lithiasis (e.g., tumors, trauma, or congenital malformations of the urinary tract).
- Files were incomplete, lacked a formal radiological report, or were missing essential study variables.

Exclusion Criteria

Records were excluded if:

- Imaging examinations were uninterpretable or of insufficient quality.
- Duplicate or redundant records were identified.

Study Type and Period

A cross-sectional analytical study of patient medical records was conducted from January 1, 2020, to December 31, 2024.

Sampling Technique

A comprehensive sampling approach was used, including all eligible medical records of patients who underwent imaging for suspected urinary lithiasis during the study period. Records that were incomplete, duplicated, or lacked usable imaging were excluded.

Study Variables

Dependent Variable

- Presence or absence of urinary lithiasis confirmed by imaging (ultrasound and/or plain radiography). Urinary lithiasis was defined as the presence of a calculous focus identified and reported by the radiologist.

Independent Variables

- **Sociodemographic variables:**
  Age (categorized as <30, 30–49, ≥50 years), sex (male/female), occupation (sedentary/non-sedentary), and residence (urban, peri-urban, rural).
- **Clinical variables:**
  Personal history of lithiasis (yes/no), acute lumbar pain (yes/no), signs of urinary tract infection (yes/no), hematuria (yes/no).
- **Comorbidities:**
  Diabetes mellitus (yes/no), hypertension (yes/no), gout (yes/no), and obesity (yes/no).
  Obesity was defined as a body mass index (BMI) ≥ 30 kg/m².

Data Collection Instruments

Data were collected through a documentary review of radiology and urology department registers, as well as patient medical records. A standardized data collection form was used for each patient to ensure consistency. All data were anonymized to maintain patient confidentiality.

Validity and Reliability

Internal validity was ensured through clearly defined inclusion and exclusion criteria applied consistently across all records. The use of standardized imaging reports reduced the risk of misclassification. Variables were defined using uniform operational criteria prior to data extraction.

External validity was supported by the inclusion of patients over a four-year period in a referral hospital; however, generalization should be made with caution.

Reliability was enhanced through the use of official hospital records, a standardized data extraction form, and cross-checking of a subset of records. Statistical analyses followed predefined procedures to improve reproducibility, while acknowledging the inherent limitations of retrospective studies.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Stata version 15. Qualitative variables were presented as

proportions. Age was normally distributed and expressed as mean ± standard deviation.

Bivariate analysis was conducted using Pearson's chi-square test or Fisher's exact test at a 5% significance level to assess associations between independent variables and urinary lithiasis. Crude odds ratios (ORs) with 95% confidence intervals (CIs) were calculated, along with corresponding Wald p-values.

Ethical Considerations

The study protocol was submitted to the Ethics Committee of the University of Kisangani and to local health authorities for approval. Patient confidentiality was strictly maintained. All personal data were anonymized or coded prior to analysis. Access to medical records was authorized by the administration of the Cinquantenaire Hospital of Kisangani. Data collection was conducted anonymously, and only members of the research team had access to the database.

RESULTS

Sociodemographic Characteristics, Clinical Aspects, and Comorbidities

The mean age of the study participants was 41.9 ± 15.3 years, with a predominance of individuals aged 30–49 years. Male participants accounted for 55.1% of the sample. Non-sedentary occupations were more frequent, while sedentary occupations represented 40.3% of participants. The vast majority of participants resided in urban areas (98.7%).

A personal history of urinary lithiasis was reported in 5.9% of participants. Acute pain suggestive of renal colic was present in 89.1% of cases. In contrast, urinary tract infection and hematuria were relatively uncommon.

Regarding comorbidities, 4.9% of patients had diabetes mellitus, and 18.2% had hypertension. Obesity was uncommon, and gout was rare.

Table 1:
Sociodemographic Characteristics, Clinical Aspects, and Comorbidities (N = 303)

Variable	Category	n	%
Age (years)	Mean ± SD	41.9 ± 15.3	—
	< 30	54	17.8
	30–49	167	55.1
	≥ 50	82	27.1
Sex	Male	167	55.1
	Female	136	44.9
Occupation	Sedentary	122	40.3
	Non-sedentary	181	59.7
Residence	Urban	299	98.7
	Peri-urban	4	1.3
Clinical Characteristics			
History of lithiasis	Yes	18	5.9
	No	285	94.1
Acute renal colic	Yes	270	89.1
	No	33	10.9
Urinary tract infection	Yes	41	13.5
	No	262	86.5
Hematuria	Yes	6	2.0
	No	297	98.0
Comorbidities			
Diabetes mellitus	Yes	15	4.9
	No	288	95.1
Hypertension	Yes	55	18.2
	No	248	81.8
Gout	Yes	3	1.0
	No	300	99.0
Body Mass Index	Normal	203	67.0
	Overweight	78	25.7
	Obesity	22	7.3

Note: SD = standard deviation.

Bivariate Analysis of Factors Associated With Urinary Lithiasis

The bivariate analysis **(Table 2)** showed statistically significant associations between urinary lithiasis and age, personal history of lithiasis, urinary tract infection, and diabetes mellitus ($p < .05$).

A personal history of lithiasis was strongly associated with the occurrence of urinary stones (OR = 3.43, 95% CI [1.02, 14.39], p = .030). Similarly, patients presenting with signs of urinary tract infection had a significantly higher likelihood of lithiasis (OR = 2.45, 95% CI [1.15, 5.50], p = .012).

Although diabetes mellitus and gout appeared statistically significant, the very small number of affected patients (n = 15 and n = 3, respectively) limits the robustness of these

findings and warrants cautious interpretation. No significant associations were observed for sex, occupation, residence, acute pain, hematuria, hypertension, or body mass index.

Table 2:
Bivariate Analysis of Factors Associated With Urinary Lithiasis (N = 303)

Variable	Category	Lithiasis Present n (%)	Lithiasis Absent n (%)	OR	95% CI	p
Age (years)	< 30	28 (17.6)	26 (18.1)	–	–	.047*
	30–49	97 (61.0)	70 (48.6)			
	≥ 50	34 (21.4)	48 (33.3)			
Sex	Male	92 (57.9)	75 (52.1)	1.30	0.78–2.04	.313
	Female	67 (42.1)	69 (47.9)	–	–	–
Occupation	Sedentary	99 (62.3)	82 (56.9)	1.20	0.77–2.03	.346
	Non-sedentary	60 (37.7)	62 (43.1)	–	–	–
Residence	Urban	157 (98.7)	142 (98.6)	1.10	0.08–15.43	1.000
	Peri-urban	2 (1.3)	2 (1.4)	–	–	–
History of lithiasis	Yes	14 (8.8)	4 (2.8)	3.43	1.02–14.39	.030*
	No	145 (91.2)	140 (97.2)	–	–	–
Acute pain	Yes	143 (89.9)	127 (88.2)	1.20	0.54–2.64	.627
	No	16 (10.1)	17 (11.8)	–	–	–
Urinary tract infection	Yes	29 (18.2)	12 (8.3)	2.45	1.15–5.50	.012*
	No	130 (81.8)	132 (91.7)	–	–	–
Hematuria	Yes	5 (3.1)	1 (0.7)	4.60	0.51–221.10	.218
	No	154 (96.9)	143 (99.3)	–	–	–
Diabetes mellitus	Yes	3 (1.9)	12 (8.3)	0.20	0.04–0.81	.015*
	No	156 (98.1)	132 (91.7)	–	–	–
Hypertension	Yes	32 (20.1)	23 (16.0)	1.30	0.71–2.52	.349
	No	127 (79.9)	121 (84.0)	–	–	–
Body mass index	Normal	108 (67.9)	95 (66.0)	–	–	.117
	Overweight	44 (27.7)	34 (23.6)			
	Obesity	7 (4.4)	15 (10.4)			
Gout	Yes	1 (0.6)	2 (1.4)	0.50	0.01–8.74	.012*
	No	158 (99.4)	142 (98.6)	–	–	–

Note: OR = odds ratio; CI = confidence interval.
p < .05 (Pearson's chi-square or Fisher's exact test, as appropriate).

DISCUSSION

This study, conducted at the Cinquantenaire Hospital of Kisangani among 303 patients evaluated for suspected urinary lithiasis, provides insight into sociodemographic characteristics, clinical features, comorbidities, and associated factors in a resource-limited setting where computed tomography (CT) is not routinely available. The findings are discussed in light of existing literature and their implications for optimizing diagnosis in such contexts.

Sociodemographic Characteristics, Clinical Aspects, and Comorbidities

The mean age of participants was 41.9 ± 15.3 years, with a predominance of individuals aged 30–49 years. This profile is consistent with recent studies from Africa and other regions, which report peak incidence of urinary lithiasis in middle adulthood (Akpakli et al., 2024; Kamadjou et al., 2023). Hospital-based series similarly report a median age of around 40 years, with a concentration of cases between 30 and 49 years (Şimşekoğlu et al., 2024). These findings suggest that exposure to metabolic and environmental risk factors is greatest during this period of life and align with global epidemiological trends (Stamatelou & Goldfarb, 2023).

Regarding sex, no significant association was observed with urinary lithiasis, in contrast to studies reporting male predominance (Alhakamy et al., 2025; Lin et al., 2025; Yao et al., 2025). This finding is consistent with recent population-based analyses showing that sex differences may diminish after adjustment for confounding factors (Stritt et al., 2026a; Szymanski et al., 2025). Additionally, sex disparities appear to vary across regions and sociodemographic contexts (Awedew et al., 2024). These observations suggest that sex alone may not be an independent determinant of lithiasis risk.

Acute renal colic was the most frequent presenting symptom (89.1%), consistent with current literature describing it as the hallmark clinical manifestation of urinary stones due to acute urinary obstruction (Wróblewski et al., 2026). Other clinical series report similar proportions (approximately 85–90%), reinforcing the consistency of our findings (Machura et al., 2024).

Signs of urinary tract infection were present in 13.5% of patients, indicating that infection is not systematic. This rate is comparable to findings reported in Saudi Arabia (17.7%) and Switzerland (6%) (Alhulaybi et al., 2024; Grossmann et al., 2022).

A personal history of kidney stones was relatively infrequent (5.9%) but emerged as a significant predictor of recurrence. This aligns with literature identifying prior lithiasis as a major determinant of future episodes (Wang et al., 2022; Leslie et al., 2025). Recent studies confirm that individuals with a history of stones have a substantially higher recurrence risk (Yasar et al., 2025), highlighting its strong prognostic value.

Comorbidities such as diabetes mellitus (4.9%) and hypertension (18.2%) were relatively uncommon, while obesity and gout were rare. Hypertension, observed in 18.2% of patients, is consistent with findings showing its association with increased lithiasis risk, even after adjustment for confounders (He et al., 2025; Nazari et al., 2025). Similar associations have been reported in cohort studies such as the Kharameh study (Moftakhar et al., 2022), suggesting shared metabolic and cardiovascular pathways.

Factors Associated With Urinary Lithiasis

In this study, the 30–49 age group had the highest proportion of urinary lithiasis cases (61.0%), with a statistically significant association between age and disease occurrence (p = .047). This finding is consistent with Global Burden of Disease analyses showing a high burden among working-age adults (Yao et al., 2025). Other studies report peak prevalence in the 30–39 and 40–49 age groups (Paluchamy et al., 2024; Providence et al., 2025), likely reflecting the influence of metabolic, dietary, and environmental exposures.

A personal history of kidney stones was strongly associated with recurrence (OR = 3.43, p = .030), confirming the recurrent nature of the disease. This finding is supported by data from the SKIPOGH cohort (Stritt et al., 2026b) and a large meta-analysis involving nearly 500,000 participants (K. Wang et al., 2022). Predictive models and European guidelines consistently identify prior lithiasis as a key risk factor (Lei et al., 2025; Skolarikos et al., 2025).

A significant association was also observed between urinary tract infection and urinary lithiasis (OR = 2.45, p = .012). This aligns with evidence demonstrating a bidirectional relationship between infection and stone formation, particularly through urease-producing bacteria and biofilm formation (Razi et al., 2024; Ripa et al., 2022).

An inverse association was observed for diabetes mellitus (OR = 0.20, p = .015), which contrasts with studies linking insulin resistance to increased lithiasis risk. However, recent evidence suggests that the relationship between glucose metabolism and lithiasis is complex and may vary depending on metabolic profiles (Shen et al., 2024). Some studies also report that improved insulin sensitivity may reduce lithiasis risk (Yang et al., 2025). This finding may reflect treatment effects or metabolic control and should be interpreted cautiously.

Although gout is classically associated with uric acid stones, no significant association was observed in this study, likely due to its low prevalence. Previous research supports a strong link between hyperuricemia and lithiasis (Ferraro et al., 2017; Jin et al., 2024), suggesting that the lack of association here reflects limited statistical power rather than absence of a true relationship.

Body mass index (BMI) was not significantly associated with lithiasis (p = .117), in contrast to several large-scale studies reporting a positive association (Wang et al., 2023; Zhou et al., 2025). However, inconsistencies across populations have been reported (Katebi et al., n.d.), suggesting that demographic and methodological factors may influence this relationship.

Limitations of the Study

This study has several limitations related to its retrospective design and resource-limited setting:

1. Diagnosis relied primarily on ultrasound and plain radiography, which are less sensitive than CT scanning, particularly for ureteral stones.
2. The small number of patients with certain comorbidities (e.g., diabetes and gout) limited statistical power and the robustness of associated findings.
3. The absence of data on stone composition (e.g., infrared spectroscopy or chemical analysis) limited the ability to perform comprehensive metabolic evaluation.

These findings should therefore be interpreted as contributing valuable local data but require confirmation through prospective studies incorporating CT imaging and stone analysis.

https://dx.doi.org/10.4314/orapj.v7i2.19

CONCLUSION

This study highlights the epidemiological and clinical profile, as well as factors associated with urinary lithiasis, in a resource-limited setting where CT scanning is not routinely available. Urinary lithiasis predominantly affects young and middle-aged adults, particularly those aged 30–49 years, and is strongly associated with a personal history of lithiasis and the presence of urinary tract infections. These findings underscore the recurrent nature of the disease and the importance of systematic screening for urinary tract infections.

From a practical perspective, strengthening targeted screening using ultrasound and radiography is recommended. Early diagnosis is essential, particularly among symptomatic patients and those with a history of lithiasis. Management strategies should emphasize recurrence prevention through patient education on adequate hydration, regular follow-up, and appropriate treatment of urinary tract infections.

The notable prevalence of hypertension suggests the need for routine metabolic and cardiovascular assessment in patients with urinary lithiasis. Finally, prospective multicenter studies are recommended to better clarify the roles of metabolic factors, diabetes, and BMI in this context and to guide the development of locally adapted prevention and management strategies.

Acknowledgments: The authors sincerely thank the Cinquantenaire Hospital of Kisangani and the staff of the Department of Radiology and Medical Imaging for their support.

Author Contributions: Bambale, J.-P. L. conceived the study, collected and interpreted the data, and drafted the manuscript. Bambale, J.-P. L. and Kakule, L. L. performed data analysis and revised the manuscript. Ahuka, L. L., Kakule, L. L., Mbongo, A. T., Falay, D. S., Tagoto, A. T., and Bisuta, S. F. critically reviewed the manuscript. Kayembe, C. T. and Molua, A. A. supervised the study and contributed to interpretation and revision. All authors read and approved the final version of the manuscript.

Ethical Approval: Ethical approval was obtained from the Ethics Committee of the University of Kisangani (Approval No.: UNIKIS/CE/KGB/004/07/2025).

Conflicts of Interest: None declared.

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